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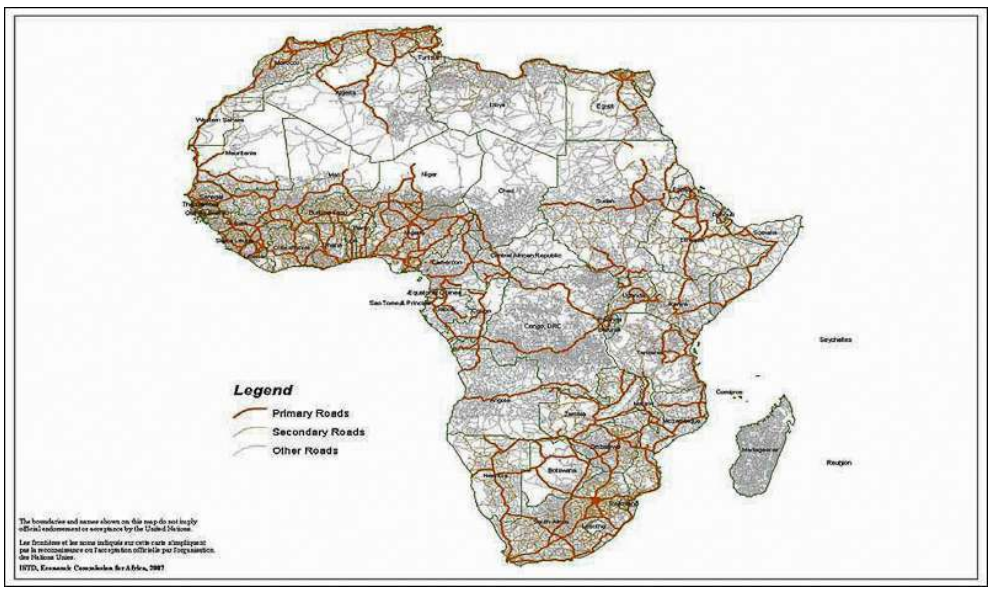
> The mystery of Africa was at least a question of
> traffic lanes and mechanical traction vehicles!
> Therefore other mysteries could appear tomorrow,
> as in Africa, a pure question of modernization of
> the means of transport!
> Alberto Moravia, African walks, 1987

1 To develop their resources and their capabilities (Sen, 2001) the African States in general, and the western ones in particular, must confront the weakness of their transportation networks which are crucial vectors of development. This fact has been demonstrated by many scholars, seeking to demonstrate the role of transportation networks in the territorial structuration of the world (Taaffe, Morrill, Gould, 1963; Rimmer, 1977; Hoyle and Knowles, 1998; Debrie, Eliot, Steck, 2003). Roads are both the condition and the materialization of exchange (Plassard, 1995; Offner, Pumain, 1996; Gasser et al., 2004). Furthermore, without roads, nothing can be done to establish an effective process of development. People are claiming roads as instruments of their mobility and as the means to attempt better conditions of life. How could it be possible to go to school, to hospital, or to market place without roads? How could it be possible to sell the products of agricultural activities? How could it be possible to satisfy ordinary needs which are increasing, according to a perception of other ways of life lived abroad, consuming many more manufactured goods? This paper aims to contribute to a better understanding of the role of roads as instruments of development (Porter, 1995; Grieco, 2009). In a first part, it will draw a kind of panorama of the problems which African countries have to face in the field of transport infrastructures. In the second part, it will demonstrate some of the main effects of opening a new road, based on the example of the Nouakchott-Nouadhibou road in Mauritania. In a third part, we shall highlight the question of accessibility.

The lack of solid roads

2 In Africa, the inadequate provision of solid roads produces serious negative effects. In Africa, there is only 6.84 km of road for every 100 km² (UNECA, 2007), much less than in South America (12 km per 100 km²) and Asia (18 km per 100 km²). The development process is limited by a reduction of the fluidity of traffic concerning both the movement of people and that of goods. But beyond strictly economic imperatives, this issue is particularly acute for African States. Such territories reveal the heritage of colonization, which means that boundaries drawn by European countries have been accepted by independent States as the expression of their own sovereignty. At the same time, African States are moving towards large supranational entities that aim to open up their economies to the global system of worldwide exchange. Even though they need to achieve the building of national space, African States must also connect their infrastructure into a growing process of network creation within the evolving regional system. In so doing, they are rediscovering old configurations of terrestrial networks established prior to colonization. These links shaped spatial configurations that have been disrupted and displaced by new routes, namely those ordered by the logic of foreign domination (Debrie and Steck, 2001). Employed by dynamic local economic actors, these older networks have never completely disappeared. But the establishment of borders and the necessities of globalization, promoted by colonization, opened new transport routes. Networks are thus at the junction of political, social and economic imperatives. Networks are the condition to emergence of national consciousness based on sovereign territorial entities. At the same time, networks are the main path toward development because they are the means for the dissemination of progress.

Illustration 1 - The primary roads in Africa



UNECA, 2007.

The asphalt road, a necessity

3 Networks of highways, temporary tracks, permanent tracks, strengthened tracks, asphalt roads, and motorways, are decisive for the future. Undoubtedly there is an emergency to modernize and develop rail tracks, which in theory are effective tools for assisting development in poor countries. But, as railway companies are often in a condition of disturbing neglect, they serve only a small part of West Africa and mostly for the transportation of goods (Chaléard, Chanson-Jabeur, Béranger, 2006). At the same time, the benefits of air transport are evident as an instrument in the opening up of territory and in the reduction of distance, but their capabilities are limited and the situation caused by the effects of world air transport deregulation has made them worse. It could be possible also to use waterways, such as the Senegal, Niger, and Congo rivers, which could play a major role in regional communication but these watercourses are so far unable to satisfy the requirements of modern transport, whatever the institutional structures in place, such as the OMVS (Organisation pour la mise en valeur du fleuve Sénégal: http://www.omvs.org).

4 In West Africa, roads still provide the major pathway to territorial development and integration into the regional and global trade system, carrying at least 80 % of the goods traffic (UNECA, 2007)), even if international institutions and many governments in the global North want to limit the use of cars and trucks. The main corridors setting up new territories in Africa are mostly road corridors (Pelletier, Alix, 2011). But it is not enough to create new tracks or to maintain old ones. Beyond a rather sterile debate on the choice between installing major infrastructures or networks of local routes, asphalt roads provide the link sought by the people, by transport operators, and also by local and national authorities. Roads improve mobility by offering greater efficiency of displacement. Asphalt roads allow traffic to move at speeds greater than those possible along tracks. Although there is no universally significant average value, experience shows that the maximum speeds on asphalt roads may be more than 80 kilometers per hour, while on many tracks, they are often reduced to 20 or 30 kilometers per hour. To be successful, the road must be in good condition and without major degradation, which is unfortunately not always the case. Asphalt roads avoid the risk of dust being raised by vehicles on dirt tracks during the dry season, especially the hazards resulting from reduced visibility. They remove the discomfort of driving on a so-called corrugated road. They reduce mechanical risks concerning brakes, steering, tyres, and suspension. They also diminish the risk of loss of control when tracks are transformed into a kind of marsh during the rainy season. Asphalt roads allow movement throughout the year, even during the rainy season and the period of floods, and are especially effective when bridges or dikes have been built. In other words, asphalt roads can lead to lower transportation costs, permitting more flows in a common unit of time and providing increased security, unless excessive speed, unfriendly driving practices and poor maintenance of vehicles reduce these positive effects. Difficulties can also be reduced by maintaining the roads in good condition. It is common that degraded roads are duplicated by diversions on to spontaneous tracks adopted by drivers. Indeed, it is not enough to have a linear form of asphalt; it must also be kept in good condition. The financial means of the States concerned are unfortunately often inadequate to keep the roads in good enough order to satisfy the needs of mobility. To create new asphalt roads, African States can obtain international funding, mostly multilateral in character, through the World Bank and

other agencies. But for maintenance, they must rely primarily on their own internal resources.

The architecture of the networks of asphalt roads is controlled by borders

5 Colonization did not bequeath many asphalt roads to Africa and five decades of independence and development, claimed as sovereign, have not led to decisive results, even if the linear growth is sometimes spectacular in some States, as for example in Nigeria. Networks are first and foremost all national. A border effect is very evident. It is the result of former colonial rivalries as well as the failure of programmes of regional integration organized by colonization, such as the AOF (French West Africa). It has also to do with the will of governments after independence to build a State that can be recognized by all the populations living in it, as has been observed everywhere in the world (Debrie, 2010). In other words, States have preferred infrastructure policies contributing to build a real sense of national belonging rather than to promoting transnational infrastructure programmes, for fear of generating centrifugal forces. Today, crossing borders by asphalt roads constitutes one of the most important challenges. The lack of modern roadways connecting States is an obstacle weakening both the expression of economic integration and actual progress along that path. But, at the same time, economic differentials caused by the borders, have also encouraged activities; indeed, borders are also creative places (Grégoire et Labazée, 1993).

6 In an extended West Africa, from Mauritania to Congo, there were only twenty-eight border crossings on asphalt roads in the 1990s. The situation has improved since 2000 but there are still not enough. Among the continental States, seven have no hard-surface road linkages with neighbouring States; three have only one. Most asphalt border links are internal to the West African area. There is only one asphalt link between West Africa and North Africa (Morocco, Algeria, Libya), namely the western route between Morocco and Senegal via Mauritania, achieved by the opening of the Nouakchott-Nouadhibou road in 2004. Links between capitals are almost completed in West Africa, but they are very new and the network is only composed of single roads connecting the capitals of those States.

An incomplete network

7 One can observe two roughly parallel axes, from West to East: one in the North, linking Mauritania to Chad, the other in the South, “the coastal line”, between Senegal and Cameroon, even though this is not fully completed. These two main highways are linked together by North-South asphalt roads, a sign of continuing development. However, vast territories remain that are completely deprived of modern highways, particularly between Senegal and the Ivory Coast in this region of the southern rivers, in which one finds some of the poorest and politically most unstable States in the world. In this area, some of the most atrocious civil wars took place in past decades. It involves Guinea Bissau, Guinea, Sierra Leone and Liberia. The network is also deficient from Chad to Congo through Cameroon and the Central African Republic, in the peripheries of Central Africa, which are sparsely populated, poorly equipped, and composed of difficult forest environments. To the North, the vast desert, from Mauritania to Chad, suffers from a low density of settlement and lacks modern roads. Very ancient tracks still cross the Sahara

but establishing modern links between the two shores of the desert remains an objective for the future. Morocco, Algeria, Libya are still constructing asphalt roads, opening the way to the southern States of the Sahara, but political instability is slowing down the opening of main roads through the desert.

8 Within this framework, one must notice the lack of reliable statistics. However, it is possible to emphasize a few special cases: Nigeria especially, but also Ghana, Côte d'Ivoire, even Senegal, Mauritania and Cameroon. Burkina Faso, for its part, is distinguished by a considerable effort to develop its central position as a major crossroads in the Sudano-Sahelian West African area, thereby allowing it to claim a vital role in the overall circulation of the region.

9 The surface directly served by asphalt roads appears as a good criterion of differentiation. Despite being impossible to assert its legitimacy strictly, we have chosen to consider the spaces within five kilometres of an asphalt road, which represents about an hour of walking in those societies where this is still the main means of travel. Very large disparities appear: in Guinea Bissau, Togo, Nigeria and Gambia more than 20 % of the area is located within 5 kilometres of a asphalt road, whatever the quality of the surface; then come Senegal 18 %, Côte d'Ivoire 13 %, Ghana 12 %; and at the lower end of the series, Chad 0.16 %, Central African Republic 1.03 %, Mauritania 1.78 %, Mali 1.81 %, Gabon 2.51 %, Niger 2.61 %. The average space within five kilometres of an asphalt road is only 3.5% for the whole of West Africa. One could say that the area is not in itself a relevant indicator. It would be much more legitimate to know the proportion of population affected by this proximity. That opinion is valid but it would require accurate, consistent and reliable demographic databases, which are not yet in existence. Several distinct studies have revealed the attraction of asphalt roads on the location of population. In a certain way, if the roads do not go to the people, people do go to the roads. There is a good correlation between the length of asphalt roads and population (0.96). The more a State is populated, the longer is its network. The establishment of networks is effectively conditioned by the public will to serve populations, strengthening both State and territorial control and the economy, by facilitating movements of people and of wealth. However, establishing a relationship between the length of the network and a common unit of one hundred inhabitants, does not yield such obvious results, taking into account an average regional value of 3 km of asphalt roads per 100 inhabitants. The States with small population totals form two major groups. The first brings together those where the length of the network at the disposal of 100 inhabitants is high, such as Cape Verde (47 km/100 inhab.), but also Equatorial Guinea (13 km/100 inhab), Sao Tome and Principe (8 km/100 inhab), Gambia (7 km/100 inhab), and Mauritania (7 km/100 inhab), each of which lag far behind. The second group involves States with small population totals and where the length of the road network at the disposal of each 100 inhabitants is very low, such as Chad, Benin, and Central African Republic. These differences demonstrate the inequality of wealth and of access to asphalt roads.

10 This inequality may be clarified by calculating the average that can be established between the length of asphalt roads and wealth produced. The regional average is 0.81 km of asphalt roads for 1 million US$ of GNP. The correlation is still high (0.95). Cape Verde, Equatorial Guinea, and Sierra Leone head the league; Gabon, Guinea, Chad, and Cameroon come at the bottom.. However, those differences can reveal quite dissimilar situations. The largest regional States, apart from Nigeria, in fact invest in roads less than small States, according to their GNP. There is no sample answer to the main question of

the effects of new roads on the development. Increasing the linear of asphalt roads is a condition of it but not the only one. If the Côte d'Ivoire had the same index as Equatorial Guinea, it would mean that its GNP would be six times greater than it actually is. The question deserves to be asked, even if this scenario ignores many parameters that are not considered here.

11 All those questions need to be confronted to what is really going on in the proximity of people waiting for improvements in their ordinary life. The case study that follows is significant of several main evolutions observed everywhere in Western Africa, even if it's a very special case, because of the environmental challenge it has to face.

The opening of the Nouakchott-Nouadhibou road (Mauritania)

12 Over the last decade, the "Parc National du Banc d'Arguin" (PNBA) in Mauritania, considered as one of the most important places in the world for the protection of natural environments (UNESCO world heritage), became a major territorial issue for divergent interests. Its maritime part is attractive for fishermen, although access is prohibited to all those who are not identified as Imraguen, the local fishermen. The area is appreciated by nomads for grazing their sheep and camels. It is a focal point for oceanographers, geologists, ornithologists and botanists. It is also a destination for tourists looking for empty, deserted spaces, and also for bird lovers and those seeking cross-cultural encounters. The PNBA is facing new challenges and increasing pressures, since it has become easily accessible from the Nouakchott-Nouadhibou road that was opened in 2004. This road forms an excellent laboratory for enhancing scientific thinking about the effects of a new transport route on structuring the territories and local people. The main issue is how to reconcile economic imperatives with the preservation of vulnerable environments. On the one hand, national policies are fostering economic growth by developing potential sources of activities, according to the wishes of people for better living conditions. On the other hand, it is crucial to maintain biodiversity, especially birds and fishes, within the context of what is called sustainable development. Road development can give rise to contradictory outcomes. Opening a new road can certainly improve the condition of local inhabitants but may also submit them to external actors who will impose changes that they do not want. At the very least, it can bring about partial destruction of environments, thereby harming the lifecycles of fish and birds, or even of plants that are overexploited by the inflow of herds of livestock or by increasing connections to urban markets. This road is exemplary, first because it is involved in various scales of territorial operation; second, because its opening has led to many transformations already, even though it is too early to assess the effects over the medium term or the long term. The existence of the road in particular modifies the accessibility of places, a powerful factor of potential evolutions of the PNBA (Seneh, Steck, 2011).

A multiscalar trans-Sahara Highway

13 The Nouakchott-Nouadhibou road must be considered at three scales: local, national and international. The question of its contribution to development has therefore to deal with the question of interactions between different interests whose purposes are not similar.

Illustration 2 - The Nouakchott-Nouadhibou road

Seneh, Steck, 2011.

The impact of the road on the littoral

14 Whilst this is not its primary purpose, the road plays a quite decisive role in the organization of space that it crosses. It runs along the coastline for almost 470 km, that is two thirds of the littoral of Mauritania, even if it moves up to 60 km away of it because of the presence of the PNBA. However, this road serves to integrate the littoral into the territory of the nation. It offers new opportunities to local populations. It allows the Imraguen to supply Nouakchott and Nouadhibou fish markets much more actively than before. It also allows them to consume more easily various external goods and services (such as education, health care, and water) that were previously difficult to access. It also makes it also easier for tourists to come, in the frame of a national policy to encourage tourism. However, this road is full of ambiguities: it can lead to significant economic benefits for the Imraguen, whilst at the same time generating more pollution and exacerbating risks for vulnerable natural environments. In addition, this road, in its southern part, to the South of the PNBA, facilitates the implementation of two other major infrastructural projects: the Nouakchott international airport and the port of Tanit. At least, the road paves the way for the exploitation of previously unexploited resources, such as the Tasiast gold mine and the hydrocarbon reserves identified off-shore close to the PNBA. The road aims to satisfy all these interests which are difficult to reconcile. For example, preservation of natural areas, until recently protected by their relative isolation, need to be reconciled with the wish of local people for better living conditions.

The opening of a road linking the two main Mauritanian cities

15 At the national level, the main objective of this road is to link the political capital, Nouakchott, to the economic capital, Nouadhibou. These two cities contain about a third of the population and constitute the main economic poles of production and consumption. Nouadhibou is the second city of the country behind Nouakchott to which it was not connected by hard roads until recently. Prior to the opening of the asphalt road, exchanges between Nouadhibou and the rest of the country were low, considering the economic and commercial potential of this city. Nouadhibou had very few links with Nouakchott, compared with its regular relations with Las Palmas in the Canary Islands or with Morocco and Spain, not to mention the specific enclave of the national industrial and mining company (SNIM) that positioned a part of Mauritanian territory in the globalized raw materials trade. As a gateway to Europe and cosmopolitan city, Nouadhibou had more to do with international partners than with national ones. The road, as an instrument of territorial control, has certainly modified this initial characteristic (Antil, Choplin, 2003). Linking the two major cities of Mauritania, the Nouakchott-Nouadhibou road facilitates economic exchanges between the commercial foci represented by the ports of Nouakchott and Nouadhibou, the Nouadhibou ore terminal and the two airports.

A new link between West African and the Maghreb

16 At the scale of international relationships, this road axis is becoming one of the fundamental links between the Maghreb and West Africa, indeed the first one to be completed, before other routes are opened between Algeria and Mali, or between Libya and Chad, for example. It allows, on the one hand, an increasing potential for Mauritanian integration to these two sub-regions, strengthening its position as an interface, and on the other hand providing the first asphalted fixed-link connection between West Africa and Europe (admittedly the Senegal River and the Strait of Gibraltar have to be crossed). This road is also a new solution for opening up some countries of the West African sub-region, such as Mali which seeks to escape from an uncertain relationship with the Côte d'Ivoire and which is now linked by asphalt roads both to Dakar and to Nouakchott, and therefore to this first transsaharan axis. For example, traders based in Bamako can buy fish in Nouadhibou and sell it two days later in Bamako. For Morocco, which experiences a certain diplomatic isolation in Africa because of conflict in the Western Sahara, this road brings about a Rabat-Nouakchott-Dakar axis, and even, one may say, an axis from Paris and Madrid to Rabat and Dakar.

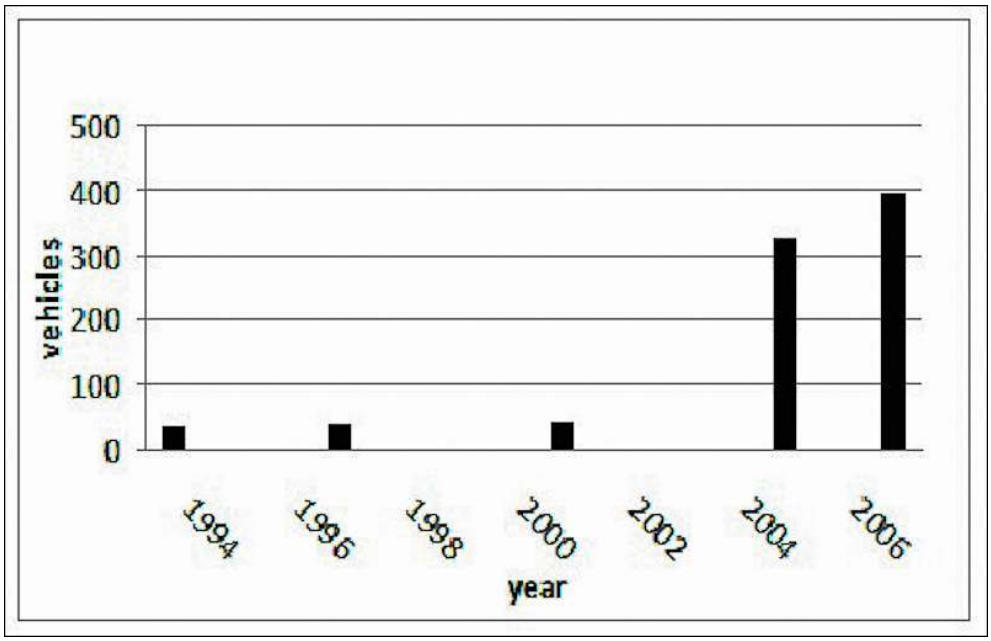
The effects of the road on the territorial organization

17 The Nouakchott-Nouadhibou link is a good demonstration of what goes on when a new asphalt road is opened. Its opening modifies completely the accessibility of the PNBA, considering accessibility as the process of interaction between an array of factors that are not all necessarily in direct relation with mobility. A road can actually promote the accessibility of places, enabling interrelationships between separate processes. But improving accessibility can also deeply disrupt the local population in their relation with the outside world. The question that arises concerns the capacity of the Nouakchott-Nouadhibou road to stimulate interactions in favour of the populations concerned.

A strong increase in traffic

18 First, the opening of the road led to a strong increase of traffic within five years (thirty times more), even if uncertainties remain over counts made by the national technical services in Mamghar, on the trail through the Park, for the years prior to the opening of the new road. These counts are, however, a reference to attempt to assess the magnitude of changes introduced by the asphalt road. At the same time, surveys conducted after the opening are also uncertain, regardless of the methodological precautions implemented, because they do not cover changes in flows throughout the year. Despite these uncertainties, the data are eloquent. Even if it is too early to know if traffic forecasts by the State services of 1000 vehicles per day on average in 2015 will prove to be correct, the opening of this new road certainly increased the volume of traffic. It allowed needs and expectations to be satisfied, with new traffic appearing that had been unthinkable in previous years.

Illustration 3 - The traffic on the road

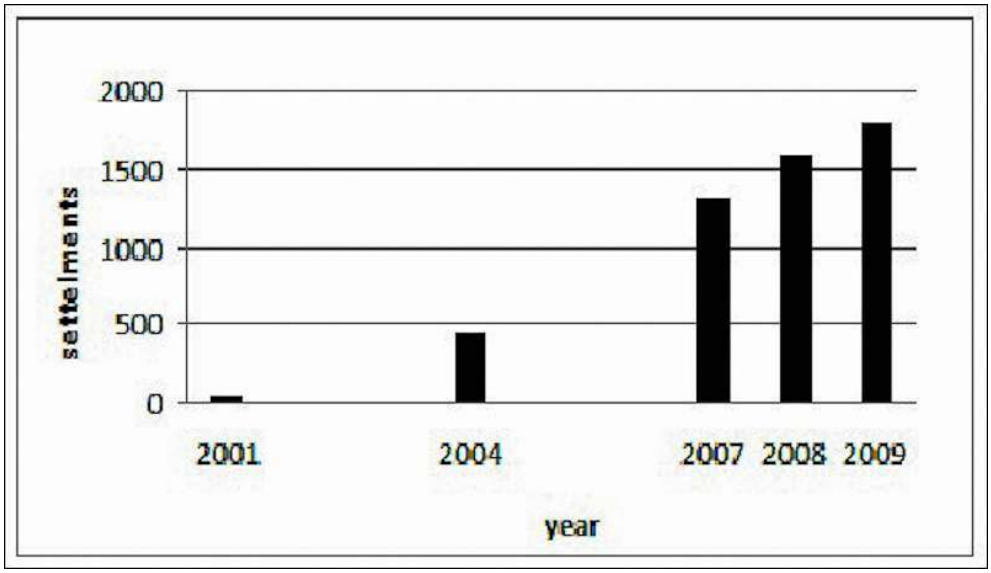


Seneh, Steck, 2011.

The road as a means of promoting settlement

19 The Nouakchott-Nouadhibou road is becoming an area of attraction not only for fishermen and pastoralists but also for new population coming from elsewhere. It is becoming a mechanism to support the prosperity of economic activities that are already established.

Illustration 4 - The settlements along the road



Seneh, Steck, 2011.

20 Yet the phenomenon has not until now reached the same magnitude as that observed on the "Road of Hope" between Nouakchott and Nema, in the southern part of Mauritania (Dede, 2006). The opening of this axis has led to new territorial configurations: urban growth of former centres (Boutilimit, Aleg, Kiffa, Aïoun, Timbedra and Nema) and development of new towns (Tintane, Guerou, Magta Lahjar). This development is explained both by the rural exodus that occurred during years of drought and by the actions of the State delivering food aid and collective social services (education, health) in these urban centers.

21 The case of the Nouakchott-Nouadhibou road is different: no pre-existing city, people widely scattered at low densities, a great scarcity of water, and many fewer activities, including those in pastoralism. The settlement policy favored by the Mauritanian State should, however, find a new field of application with the Nouakchott-Nouadhibou road. Deep drillings made during the construction of the road make water supply easier and therefore allow permanent settlements to be installed. Installation of pylons for mobile telephone operations, which have become an essential instrument of communication requested by the inhabitants, provides another feature of attraction. The road becomes a territory where one can take advantages of new opportunities offered by the flows going through. The road involves the question of accessibility, however the level of accessibility, although decisive, is only one factor among others needed to assess the impact of road infrastructure. The question of accessibility can be considered in two ways, one being quantitative and based on graph theory and the theory of gravitation, and the other being qualitative and based on a series of factors not directly measurable but nonetheless decisive.

22 The Nouakchott-Nouadhibou road promotes the creation of settlements that may become new towns in the near future. The best example is Chami, equidistant from Nouakchott and from Nouadhibou. It is a gateway to the park but it is also a place where the drivers can find gasoline, food and drink, and rooms in which to rest. More and more people want to be there; they say "This is the place to be".

The question of accessibility

23 The opening of a new road aims to improve the accessibility of places. Two kinds of accessibility are concerned. The first one is based on physical measures, according to graph theory. The second is based on what people concerned say about it, especially in the case of people living in a desert and in a protected area.

A quantitative approach to accessibility

24 We have chosen two main ways to identify accessibility: one focuses on the position of the places in the network, according to settlements or drilling sites; the other focuses on the attractiveness of these places linked to the others inside the same network.

Differential accessibility of the villages

25 Calculations applied to the Nouakchott-Nouadhibou asphalt road highlight differentiated accessibility between the Imraguen villages. A simplified graph of the tracks within the PNBA has been drawn, according to a survey of tracks by GPS made in 2008. Places, positioned according to their specific geographic coordinates, are connected by straight lines. Measuring the distances between each place of the network and all the other ones leads to a matrix classifying settlements according to their accessibility. The one which has the lowest sum of distances is the most accessible. According to this calculation, the most accessible villages are Iwik, TenAlloul and Arkeiss, and the least accessible villages are R'Gueiba, Mamghar and Agadir. Such a result shows the effects of the asphalt road. Mamghar, for example, the major village of the Park, was previously in an unavoidable position on the trail through the Park. However this village now suffers from remoteness from the asphalt road, which in turn damages its position

Illustration 5 - The Imraguen villages accessibility

Village	A(G)	Rank of accessibility
Iwik	1217,9	1
Ten Alloul	1239,6	2
Arkeiss	1303,4	2
Teïchott	1316,5	4
Tessot	1327,0	5
Awguej	1419,1	6
R’Gueiba	1474,9	7
Mamghar	1499,5	8

Agadir	1775,8	9

Seneh, Steck, 2011.

26 It is also of major interest to calculate accessibility to drilling sites, vital for development. The accessibility matrix points out better access to water for Arkeiss, TenAlloul, and Iwik, but poor accessibility for Awguej (uninhabited for several years), R'Gueiba and Mamghar. Once more the case of Mamghar appears, suffering from remoteness from the main drilling sites along the new road.

Differential attractiveness of the PNBA settlements

27 Accessibility is not only a matter of distance. It has also to deal with the attributes of each place inside the network, according to the gravity model. This model leads to so-called potential accessibility, revealing the attractiveness of the place. In fact it is strongly linked with two underlying concepts: (1) attractiveness, i.e. the ability of a place to receive flows, and (2) emissivity, i.e. the ability of a place to issue flows, in a territorial network. The selected attributes chosen are: the number of inhabitants (the essential element of central place theory which, applying the theory of gravitation to towns, stipulates that their attractiveness is proportional to their size); the number of *lanches*, the local boats, as an indicator of the major economic activity of the Imraguen and therefore likely to contribute to the assessment of their economic attractiveness; and the number of vehicles, essential instruments in the productive capacity and means of opening up places in a system of circulation and trade. From different calculations, not discussed in this paper, it appears that potentially the most accessible villages are Iwik, Teichott and Mamghar. The case of the village of Mamghar is again interesting: it went from a strong situation to one of reduced traffic flow, with most vehicles using the asphalt road nowadays. Although this village suffers from difficult geographical access, as seen in the two approaches to accessibility presented above, it appears, however, as the potentially most attractive village in the park, given the number of vehicles and *lanches,* and its demographic weight. However, its population is declining fast (944 inhabitants in 2000, according to the Census of Population and Housing, and only 462 inhabitants in 2008, according to the Baseline Survey on Population Imraguen conducted by the Ministry for the Environment and Sustainable Development and PNBA). It is true that Mamghar is still the chief town of the district and is one of the two functional bases of the Park, the other being in Iwik. However, only Iwik combines high accessibility and strong attractiveness. It could have been possible also to calculate potential accessibility based on the price of water, feed, and diesel, wich is in fact a matter of distance. For example, the village of R'Gueiba which is marked by difficult access within the network of villages, the asphalt road and drilling sites, must bear a price of a 200-litre barrel of water of up to 2800 UM (10 € in 2008), while prices at Iwik or Mamghar oscillate between 1000 and 1500 UM. By contrast, water is free in the small villages where vehicles can supply cooperatives, which is the case of Arkeiss, Agadir, Ten Alloul and Tessot.

28 The results obtained by the calculation of quantitative indicators of accessibility (graph theory and gravity model) are not sufficient to properly assess the accessibility of a place. It depends not only on its position in the network, but also on the subjective nature of

accessibility that is felt and expressed by the population, on physical constraints of the environment (soils, climate and natural resources), and on regulations in force.

A qualitative approach to accessibility

Representations of accessibility by the population

29 Accessibility is also a matter of perceptions and representations. Before the opening of this road, travel between Nouakchott and Nouadhibou took two to four days for a four-wheel-drive cars and six to eight days for trucks. Local populations have long travelled to Nouadhibou in their special boats (*lanches)* (Lopez Bargados and J. Martinez Milan, 2010). It is always the case for the inhabitants of Agadir. For long periods, water and food could only come from Nouadhibou by sea. Access to the market and other basic services (health, education, water...) was very difficult. In addition, many people died, according to the local population, because of the lack of means for a rapid escape or when drivers got lost in the midst of a desert area without water or means of communicating. The use of road vehicles increased in the 1980s but remained uncommon. The proximity of the new road encourages local residents to travel, but most of the Imraguen are still without cars, even if numbers are growing slowly. But the Imraguen know very well all the opportunities that the road brings to them, even if there are not many vehicles passing through, cars belonging to the PNBA on business, or public transport vehicles for those who reside near the road, even if most of these do not stop between Nouakchott and Nouadhibou to pick up new passengers. Despite remaining difficulties, the families of nomadic pastoralists living in the hinterland and the Imraguen believe that since the opening of the road it has become easier to move, to gain access to services, to purchase goods, and to communicate. Only the inhabitants of Mamghar and Ten Alloul report that they are more cut off since the opening of the road. This opinion confirms the results of quantitative approaches already presented. Travellers using the old Nouakchott-Nouadhibou route used to stop in Manghar where drivers could find shops and places to eat and sleep. The new road, which now bypasses the PNBA, has negative effects on the people of these two villages, because fewer and fewer people choose to drive through the PNBA. So the population has to face the paradox of the road. On the one hand, they recognize the positive effects of improvement of accessibility: reduction of costs and delays in movement, promoting the maintenance of existing activities, attracting new settlements, and providing better access to basic services. On the other hand, they understand that ease of access may become counterproductive and may generate pollution and environmental degradation caused by the development of traffic resulting from this increased and/or uncontrolled accessibility. It is this paradox that officials must seek to manage. Difficulties are growing up quickly following the effect of the road on the movement of people inside the protected area: notably, young Mauritanians who are employed on Imraguen boats, Southern Saharan migrants who come to engage in fish processing, shepherds' employees coming with their herds during favorable periods, and merchants moving more easily to reach their customers... Moreover, many young Imraguen wish to marry women "of the city". It has become easier to go to the main towns and people can easily communicate by mobile phone. Young people believe that the city is more able to satisfy the needs of their families (including school, drinking water, health...). The area of PNBA is considered as a more difficult environment because of lack of services and due to high living costs (prices of food and especially of freshwater

are higher than in the city). The asphalt road is considered to provide an opportunity to achieve better living conditions.

The physical constraints of the environment

30 Accessibility is also a matter of natural barriers that are very well known by local people. Most of the trails inside the PNBA are not marked. The former main track is certainly still dotted with markers, which are relics of past times. But in most cases, the limits of the trails are not defined clearly, and there are several bundles of tracks that lead to the same destination. Thus, a trail may reach a width of several kilometres and is in fact a wide corridor of passage. The state of the tracks depends not only on frequency of use but also on physical characteristics. Usually sandy in character, track quality depends, paradoxically, upon relative moisture. Two types of soil characterize the PNBA southern tracks:

- the first type is a sandy soil characteristic of the trails that pass through the dunes of Azeffal, Akchar, Agneitir, connecting the area of the Tijirit where is the southern entrance to the PNBA and thevillages (Mamghar, R'Gueiba, Teichott, and Tessot). These tracks are often silted and difficult to cross, especially during frequent sandstorms. This may explain the difficult access of these villages and confirm the results of the calculations of geographical accessibility;
- the second type of track has to do with *sebkhas*. The difficulty is the salinity of the soil and the risks of temporary flooding due to salt water. It is the case of tracks connecting the villages in the south of Iwik. Accessiblility declines very markedly during rain flows which are very unusual but can be brief and violent, and also at very high tides that flood the coastal *sebkhas*. In this way, absolute although temporary isolation is produced.

31 With regard to the connection of the northern villages of the PNBA from Chami to Iwik, Ten Alloul or Arkeiss and from the Wadi Chibkha or Chelkhett Leghtouta to Agadir, tracks usually are flat, hard and sometimes rocky. The Arkeiss-Agadir track which connects the South with the North of the Park is flat, sand-covered, and more or less hard, crossing virtually no *sebkhas*. This track is a fairly straight, monotonous, little frequented, with only exceptional traces of cars, hence there are few cues that can serve as a guide for travellers. Agadir is an island. So people need to use motor canoes, exceptionally permitted, from Techekche where the trail stops. Given this set of physical constraints, the villages in the south of the Park (Mamghar, Awguej, R'Gueiba, Teichott and Tessot) suffer from poorer accessibility than the villages in the North (Iwik, TenAlloul, Arkeiss). That said, the capacity of response of human societies to natural constraints can limit their effects. The modernization of transport and the expansion of Nouakchott city, afer the 1970s, have led the Imraguen to go to Nouakchoot rather than Nouadhibou, reached only by the sea, despite the awful conditions of driving to the capital. The road now enables the deployment of a complex set of relationships sometimes to Nouadhibou sometimes to Nouakchott being less ordered by the state of the tracks as was the case in the past.

A protected area

32 The distinctiveness of the Nouakchott-Nouadhibou road from other Mauritanian roads lies in its very close proximity to an area of nature protection whose importance is

recognized around the world. The PNBA covers more than 12 000 km2 (half of which are in marine areas) and is a truly exceptional ecological environment for the reproduction and rearing of many animal species. It is the largest marine herbarium of the Eastern Atlantic, the largest haven for Atlantic migratory animals, and the largest wetland area of the Sahara by virtue of its impressive biodiversity. Following designation in 1982, the PNBA is now one of the most important RAMSAR sites, and was recognized by UNESCO as a world heritage site in 1989. It receives support from the Banc d'Arguin international foundation (FIBA). It benefits from attention from international institutions charged with allocating regionally-specific designations (labels). In protected sites, environmental policies aim to limit or regulate human access on the basis of a number of ecological principles: anthropogenic pressure, capacity, workflow management, etc. The protection policy involves regulations restricting access to specific areas and prohibiting certain types of exploitation of natural and archaeological resources. In fact, these restrictions have few effects, given the relative weakness of exploitation and trafficking on the one hand, and the lack of controls on the other. Increasing pressure on these vulnerable environments, made possible by access from the asphalt road nearby, need to give rise to more restrictive measures. For example, among various problems, a worrying growth of plant poaching has been noticed. This mainly concerns the cutting of branches, with two species, *Maerua crassifolia* and *Salvadora persica* (tree roots in the area of the Agneïtir) being concerned. These species are sold in Mauritania and abroad, for example in Morocco, and also, according to some informants, in the countries of the Gulf where they are used in the pharmacopoeia and as toothpicks. But these plants are also important as a source of animal fodder and for their ability to stabilize and to fix sand dunes. They are therefore of vital significance for nomads. More serious than this plant poaching, is the threat of overgrazing that is increasing as a result of shepherds bringing herds to areas that have become more accessible as a result of the new road. One can also wonder about the spectacular increase in the exploitation of fishery resources in the Gulf of Arguin, especially of croaker, flathead mullet and sharks, during the 1990s and early 2000s. Ecological arguments led to measures in 2003 to forbid the exploitation of elasmobranches, whose survival had become very precarious because of the distinctiveness of their life cycles. The road was opened at a crucial moment, when fish species that were traditionally targeted (such as the flathead mullet) were becoming increasingly rare, fishing for very lucrative elasmobranches was prohibited, and and external operators were making increasingly insistent demands for fish supplies. This has led to a difficult dialogue between the Park officials and the fishermen. In a country where the recent application of environmental assessment as a tool for promoting sustainable development is still at a fledgling stage, the existence of the asphalt road is becoming a real problem. On the one hand, there is the fear of environmental degradation, that may prove irreversible, as a result of socio-economic changes linked to the opening of the road; on the other hand, there is the hope of benefitting from the impact of better accessibility. The real question for the future of the PNBA, following the opening of the road, is how to manage the opposition - or at least the distinction - between people and the natural world, that has given rise to contrasting arguments that have reached a state of deadlock. A new infrastructure, as an innovation, is a generator or an accelerator of territorial dynamics that profoundly change the relationship between people and the natural environment. There is no future for the Park if it is not possible to take in account the people who live there.

Accommodating planning effectiveness and social expectations

33 Building the asphalt road between Nouakchott and Nouadhibou has given rise to many crucial questions.

34 This road raises the question of reconciliation between socio-economic development for the benefit of local people and the protection of nature. This refers to the problem of "sustainable development", or more properly, according to the term used in defining protected areas, of "integrated conservation" (IUCN, 1980). This approach attempts to involve local people in the task of nature conservation, through attempting to produce an economic valuation of biodiversity (Rodary, 2011). The policy of conservation in the PNBA is being pushed by numerous non-governmental organizations and international institutions but is being challenged by local people who, increasingly, are denouncing the rules that now constrain their ancestral use of natural resources. This has led the authorities to enter into the logic of policies for "integrated conservation" which articulate nature conservation and resource management, alongside economic development and social requirements. This policy also leads to promoting the local environment as part of the distinctive Imarguen identity (Ould Cheikh, 2010). In fact, it is the policy of nature conservation which is in the spotlight. The attitude of local actors, who want to benefit from the opening of the asphalt road, is logical. It must therefore support modernization of existing production units, so-called "endogenous" elements, develop suitable storage centres, and encourage the purchase of new tools of production (such as *lanches* and nets), of processing and of transport. New attractiveness induced by the road must be thought in terms of local development strategy. It is not possible to build permanent installations in the park itself but rather on its outskirts, along the road. In such places, new economic players coming from outside the considered territory and acting in the Park according to the framework of agreements with the stakeholders, may be accommodated. The most obvious aim is to enable the people to improve their living conditions, while ensuring that there is not a rise of conflicts between different levels of actor competing for scarce resources, or further degradation of the environment to a point that would impair the livelihoods of those populations..

35 A second question is the need for further investment to open up largely landlocked territories, States or regions, that are still without modern infrastructure. For the ten next ten years, African countries need more than 250 billion US$, i.e. 5% to 6% of their GNP, to invest in road networks (UNECA, 2007). For example, the Nouakchott-Nouadhibou road cost 83.5 millions € (66% of which was paid by the *Arab fund for economic and social developmentl*). Such an effort requires funding which exceeds local investing capacities. The call for international aid is crucial but obviously entails subscribing to requirements imposed by international organizations, of which the IMF and the World Bank occupy leading rank (Teravaninthorn, Raballand, 2009). Sectoral programmes for transport improvement are part of the logic behind submitting requests for funding associated with the global liberalization of international trade. Among the partners in these policies are the European Union and China.

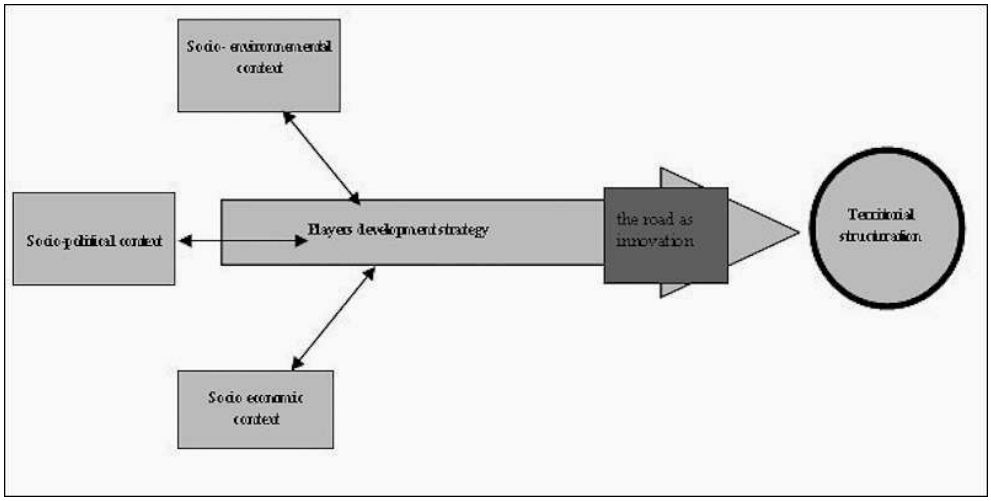
36 The third question refers to the development of exchanges, which represent a decisive instrument for promoting growth in productive activities, and carrying through progress and development. Extending road networks responds to the growing deployment of

commercial activities that characterize West Africa. "The large West African traders operate at regional, national, trans-boundary and intercontinental scales." (Grégoire and Labazée, 1993, p. 22). The growth of transport activities and the rise of local and regional actors, alongside major international groups such as Bolloré or Maersk Logistics, illustrate an often overlooked vitality. The unions of carriers are now a force of economic and political importance to all of these African countries. In the case of the Nouakchott-Nouadhibou road, it is obvious that this route offers a new opportunity for all who need better access to African markets. The increased volume of trading flows makes this evident.

37 The fourth question returns to service ports which are gateways to the world, enclaves of the world economy, places of major activities, concentrations of population, and synapses of Africa in its contact with the main regular lines of international shipping that they seek to capture. Those port cities that are better connected to the rest of the Inland territories- and are best related to back country areas experiencing growth - will have the greatest assets for ship-owners to capture as they seek to find sufficient cargo to profit from each of their stopovers. Each coastal State thus has a very real interest to build good roads to reach inland and remote territories. The inland States also seek means to put the ports in competition for their custom rather than depending on just one of them. The case of Mali that decided to establish the "Entrepôts maliens" in all the major ports from Nouakchott to Cotonou illustrates the will to loosen dependence on Abidjan alone. The Malian road network is tailored to this political objective. The Nouakchott-Nouadhibou road links two ports which could be of greater importance for this part of Africa, even if they are small on the world scale.

38 The fifth issue involves the major issue of development, that is the problem of spatial equity, moreover of sustainable development. Territorial imbalances are compounded by reticular imbalances. To increase the effort of serving territories in difficulties is a considerable but inevitable challenge. The "golden trend" is rather to strengthen the capabilities of networks that are already the most active and best equipped. International links are much preferred, according to the growth of internal trade and especially the will of most of the actors who aim to establish regional cooperation, through an ambitious programme of economic, or even monetary union. For developing States what is needed is to optimize networks already in existence. Absolute connectivity has no meaning at that time. The emphasis on privileged axes is the most effective way to operate coherent and less expensive development, even if this leads at first to an accentuation of spatial inequality. Networks must be decided and built to serve people and not to destroy their living environment. The case study of the Nouakchott-Nouadhibou road puts forward this main issue. Development is a question of human purposes before being a question of flows running faster and faster along new infrastructures, even if those provide a means of development. It all depends on how they are integrated into the territories they serve.

Illustration 6 - The road as a means of development



Seneh, Steck, 2011.

39 The launch of NEPAD (New Partnership for Africa's Development), this great ambition for a new beginning for Africa, in partnership with the most developed States, expresses very clearly the urgent need for a programme of infrastructural development, and of roads in particular, to advance towards development, focusing on human beings first.

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RÉSUMÉS

Cet article se présente comme une contribution à l'étude des infrastructures routières modernes dans le développement des territoires africains. L'Afrique souffre d'un déficit important de routes goudronnées, vecteur des flux et ouverture vers le développement social. Poursuivre le programme de construction de telles routes est un défi pour les prochaines années. Le cas de la route Nouakchott-Nouadhibou est révélateur des enjeux d'un telle prise de conscience. Son ouverture depuis 2004 s'est accompagnée d'une croissance des trafics, d'une prolifération d'installations humaines nouvelles et surtout d'une profonde ouverture des villages Imraguen bouleversant leurs rapports à l'espace environnant. Ce qui est aussi en cause c'est la protection d'un des plus importants parcs nationaux de toute l'Afrique de l'Ouest, le parc national du banc d'Arguin, désormais aisément accessible et par conséquent menacé. La question fondamentale est celle de l'articulation entre objectifs économiques et sociaux et le souci de la protection de milieux fragiles indispensables au vrai développement des populations concernées. Une route est un instrument de développement. Elle peut être aussi un instrument de destruction.

This paper aims to contribute to a better understanding of the role of roads as instruments of development. African countries have to face the lack of asphalt roads. Without such roads, the flows of goods are limited and people are unable to access easily to education, health, food and all the services. Opening new asphalt roads is one of the main challenges for the future years. The case of the Nouakchott-Nouadhibou road, in Mauritania, opened in 2004, is a fruitful example of the effects of such an infrastructure. The traffic is increasing. Many new settlements appear. The Imraguen can have better access to all the services. Beyond those effects, this road is of main interest because of its proximity to a national park, the Banc d'Arguin national Park, which is one of the most important in West Africa. The protection policy involves regulations restricting access to certain areas and prohibiting certain types of exploitation of natural and archaeological resources. The question at least is how African countries can link economic and social purposes with ecological protection for an improvement of human conditions of life. An asphalt road is a means of it but it can also be an instrument of destruction.

INDEX

Keywords : accessibility, asphalt road, Banc d'Arguin national Park, Nouakchott-Nouadhibou road, sustainable development, West Africa
Mots-clés : accessibilité, Afrique de l'Ouest, développement durable, parc national du Banc d'Arguin, route goudronnée, route Nouakchott-Nouadhibou

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